

KENDRIYA VIDYALAYA SANGATHAN, LUCKNOW REGION
SESSION : 2022-2023
CLASS- XI CUMULATIVE (HALF YEARLY) EXAMINATION

CHEMISTRY THEORY (043)
SET-2

MM:70

Time: 3 Hours

General Instructions. Read the following instructions carefully.

1. There are 35 questions in this question paper. All questions are compulsory.
2. Section A (Part-I): Q. no. 1 to 14 are MCQs type questions carrying 1 mark each.
3. Section A (Part-II): Q. no. 15 to 18 are Assertion-Reasoning type questions carrying 1 mark each.
4. Section B: Q. No. 19 to 25 are very short answer questions and carry 2 marks each.
5. Section C: Q. No. 26 to 30 are short answer questions and carry 3 marks each.
6. Section D: Q. No. 31 & 32 are case-based questions having four MCQs or Reason Assertion type questions based on given passage each carrying 1 mark.
7. Section E: Q. No. 33 to 35 are long answer questions carrying 5 marks each.
8. There is no overall choice. However, internal choices have been provided.
9. Use of calculators and log tables is not permitted.

SECTION-A (Part-I: MULTIPLE CHOICE QUESTIONS)

Following questions (No. 1 -14) are multiple choice questions carrying 1 mark each:

1. Which of the following element contains the greatest number of atoms
 - (i) 1. 4 g He
 - (ii) 46 g Na
 - (iii) 0.40 g Ca
 - (iv) 12 g He
2. The empirical formula and molecular mass of a compound are CH_2O and 180g respectively. What will be the molecular formula of the compound?
 - (i) $\text{C}_9\text{H}_{18}\text{O}_9$
 - (ii) CH_2O
 - (iii) $\text{C}_2\text{H}_4\text{O}_2$
 - (iv) $\text{C}_6\text{H}_{12}\text{O}_6$

OR

16 g of oxygen has same number of molecules as in...?

- (i) 16 g of CO
 - (ii) 36 g of H_2O
 - (iii) 14 g of N_2
 - (iv) 1.5 g of H_2
3. For which one of the following species, Bohr's theory is not applicable?
 - (i) He^{2+}
 - (ii) Li^{2+}
 - (iii) Be^{3+}
 - (iv) H

4. An orbital can have maximum electrons equal to

- (i) 2
- (ii) 10
- (iii) 6
- (iv) 14

OR

Shape of s and p orbitals respectively are-

- (i) spherical, dumb-bell
- (ii) Both are dumb-bell
- (iii) Both are spherical
- (iv) dumb-bell, spherical

5. The angular momentum of an electron is zero. In which orbital may it be present??

- (i) 2s
- (ii) 2p
- (iii) 3d
- (iv) 4f

6. Principal, Azimuthal and magnetic quantum numbers are respectively related to

- (i) Size, shape and orientation
- (ii) Shape, size and orientation
- (iii) Size, orientation and shape
- (iv) None of the above

7. Among halogens the correct order of amount of energy released in electron gain (i.e., electron gain enthalpy) follows:

- (i) $F > Cl > Br > I$
- (ii) $F > Cl < Br > I$
- (iii) $F < Cl > Br > I$
- (iv) $F < Cl < Br < I$

8. The elements in which electrons are progressively filled in 4f-orbital are called?

- (i) Actinoids
- (ii) Transition elements
- (iii) Halogens
- (iv) Lanthanoids

OR

The order of screening effect of electrons of s, p, d and f orbitals of a given shell of an atom on its outer shell electrons is:

- (i) $s > p > d > f$
- (ii) $f > d > p > s$
- (iii) $p < d < s < f$
- (iv) $f > p > s > d$

9. The number of sigma and pi bonds in $CH_3-CH=CH_2$ are...?

- (i) 7 sigma 2 pi
- (ii) 8 sigma 1 pi
- (iii) 7 sigma 1 pi
- (iv) 8 sigma 2 pi

10. Which of the following bonds has maximum ionic character:

- (i) B-H
- (ii) N-H
- (iii) O-H
- (iv) C-H

11. What type of hybridisation is involved in SF_6 ?

- (i) $\text{sp}^3 \text{d}^3$
- (ii) $\text{sp}^3 \text{d}^2$
- (iii) $\text{sp}^3 \text{d}$
- (iv) sp^3

OR

Which of the following angle corresponds to regular tetrahedral geometry?

- (i) 120°
- (ii) 90°
- (iii) 180°
- (iv) 109.28°

12. Third law of thermodynamics provides a method to evaluate which property?

- (i) Absolute Entropy
- (ii) Absolute Enthalpy
- (iii) Absolute Energy
- (iv) Absolute Free Energy

OR

In which of the following process, a maximum increase in entropy is observed?

- (i) Dissolution of Salt in Water
- (ii) Condensation of Water
- (iii) Sublimation of Naphthalene
- (iv) Melting of Ice

13. For an ideal gas, C_v and C_p are related as :

- (i) $C_v - C_p = R$
- (ii) $C_v + C_p = R$
- (iii) $C_p - C_v = RT$
- (iv) $C_p - C_v = R$

14. Which of the following is correct for the reaction with $H = +ve$ and $S = +ve$?

- (i) Spontaneous at high temperature
- (ii) Spontaneous at low temperature
- (iii) Non-spontaneous at high temperature
- (iv) Non-spontaneous at all temperatures

SECTION-A (Part-II: ASSERTION REASONING QUESTIONS)

In the following questions (Q. No. 15 - 18) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
- b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
- c) Assertion is correct statement but reason is wrong statement.
- d) Assertion is wrong statement but reason is correct statement.
- e) Both assertion and reason are false.

15. Assertion: In a gaseous reaction, the ratio of volumes of reactants and gaseous products is in agreement with their molar ratio.

Reason: Volume of gas is inversely proportional to its moles at particular temperature and pressure.

16.Assertion: Black body is an ideal body that emits and absorbs radiations of all frequencies.

Reason: The frequency of radiation emitted by a body goes from a lower frequency to higher frequency with an increase in temperature.

17.Assertion: Boron has a smaller first ionisation enthalpy than beryllium.

Reason: The penetration of a 2s electron to the nucleus is more than the 2p electron, hence 2p electron is more shielded by the inner core of electrons than the 2s electrons.

OR

Assertion: First ionisation energy for nitrogen is lower than that of oxygen.

Reason: Across a period effective nuclear charge decreases.

18. Assertion: Though the central atom of both NH_3 and H_2O molecules are sp^3 hybridised, yet H-N-H bond angle is greater than that of H-O-H.

Reason: Nitrogen has one lone pair in NH_3 and oxygen has two lone pairs in H_2O and order of electron pair repulsion follows- $\text{lp-lp} > \text{lp-bp} > \text{bp-bp}$.

SECTION-B

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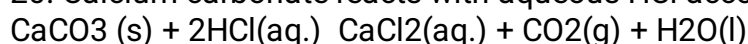
The following questions, Q. No. 19 – 25 are Very Short Answer Type and carry 2 marks each.

19. How many moles of methane are required to produce 22 g CO_2 (g) after combustion?

OR

Determine the empirical formula of an oxide of iron which has 69.9% iron and 30.1% dioxygen by mass. [Atomic mass : Fe = 55.85, O = 16.00]

20. Calcium carbonate reacts with aqueous HCl according to the reaction:



What mass of CaCO_3 is required to react completely with 25 mL of 0.75 M HCl?

21. The mass of an electron is 9.1×10^{-31} kg and its kinetic energy is 3×10^{-25} J. Calculate its wavelength. (Given $h = 6.62 \times 10^{-34}$)

22. Explain the following terms:

- (i) Electron gain Enthalpy.
- (ii) Inert gas radii

23. Although the electronegativity of F is highest but net dipole moment of NF_3 is less than that of NH_3 . Give reason.

OR

Calculate formal charge on each O-atom of ozone molecule and draw its resonating structures.

24. Give the shapes of following covalent molecules using VSEPR theory :

- (a) ClF_3 (b) XeF_4

25. Give one point to differentiate the following thermodynamic terms:

- (a) Extensive properties and intensive properties.

(b) Isothermal process and isobaric process.

SECTION-C

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Q. No. 26 -30 are Short Answer Type carrying 3 marks each.

26. Define limiting reagent. In the reaction- $2A + 4B \rightarrow 3C + 4D$, when 5 moles of A reacts with 6 moles of B, then- (i) which is the limiting reagent? (ii) calculate the amount of C formed.

OR

Calculate the concentration of nitric acid in moles per litre in a sample which has density 1.40 g mL^{-1} and the mass percent of nitric acid in it being 69%. (Atomic mass: N=14u, H=1u, O=16u).

27. Give the name and electronic configuration of the elements of 3d- series of transition metals which violate Aufbau's principle. Give reason for the same.

28. Compare the relative stability and magnetic nature of the following species on the basis of molecular orbital theory: O_2^+ , O_2^- , O_2^{2-}

OR

Use the molecular orbital energy level diagram to show that N_2 would be expected to have a triple bond and Ne_2 , no bond.

29. Write the equation showing relationship between G, enthalpy change and entropy change. How does the sign of G help in predicting the spontaneity/non-spontaneity of a process? Explain.

30. State the first law of thermodynamics. Write its mathematical expression. In a process, 701 J of heat is absorbed by a system and 394 J of work is done by the system. Determine the change in internal energy.

SECTION- D

Q. No. 31 & 32 are Case Based Questions carrying 4 marks each.

31. Read the passage given below and answer the following questions: (4 x 1= 4)

A large number of orbitals are possible in an atom. Qualitatively these orbitals can be distinguished by their size, shape and orientation. An orbital of smaller size means there is more chance of finding the electron near the nucleus. Similarly, shape and orientation mean that there is more probability of finding the electron along with certain directions than along others. The principal quantum number determines the size and to large extent the energy of the orbital. Azimuthal quantum number, 'l' is also known as orbital angular momentum or subsidiary quantum number. It defines the three-dimensional shape of the orbital. Each shell consists of one or more subshells or sub-levels. The number of sub-shells in a principal shell is equal to the value of 'n'. Magnetic orbital quantum number- 'm_l' gives information about the spatial orientation of the orbital with respect to a standard set of co-ordinate axis. The fourth quantum number is known as the electron spin quantum number (m_s). An electron spins around its own axis, much in a similar way as the earth spins around its own axis while revolving around the sun.

In the following questions, a statement of assertion followed by the statement of reason is given. Choose the correct answer out of the following choices:

- (a) Assertion and reason both are correct statements and reason is the correct explanation for assertion.
 (b) Assertion and reason both are correct statements and reason is not the correct explanation for assertion.
 (c) Assertion is the correct statement but reason is wrong statement.
 (d) Assertion is the wrong statement but reason is correct statement.

(1) Assertion: Each orbital is designated by three quantum numbers labelled as n , l and m_l .

Reason: ' n ' is a positive integer with value of $n = 1, 2, 3$.

(2) Assertion: The principal quantum number identifies the shell.

Reason: Size of an orbital decrease with the increase of principal quantum number ' n '.

OR

Assertion: The energy of an electron is largely determined by its principal quantum number.

Reason: The principal quantum number n is a measure of the most probable distance of finding the electron around the nucleus.

(3) Assertion: For $n = 2$, the possible value of l can be 0 and 1.

Reason: For a given value of n , l can have values ranging from 0 to $n - 1$.

(4) Assertion: Each electron in an atom has either $+\frac{1}{2}$ or $-\frac{1}{2}$ spin quantum number.

Reason: Spin quantum numbers are obtained by solving Schrodinger wave equation.

32. Read the passage given below and answer the following questions: (4 x 1 = 4)

Modern periodic law states that, "The physical and chemical properties of elements are the periodic function of their atomic numbers." In modern periodic table, the elements are arranged in order of increasing atomic numbers. The so-called "long form" of the Periodic Table of the elements is the most convenient and widely used. The horizontal rows are called "periods" and the vertical columns are called "groups". There are altogether seven periods and eighteen groups. Elements having similar outer electronic configurations in their atoms are arranged in vertical columns, referred to as groups or families. Critical examination of the electronic configuration of the various elements clearly indicates that with a gradual increase in atomic number there occurs a repetition of similar electronic configuration and therefore, repetition of similar properties after certain regular intervals. These regular intervals being 2, 8, 8, 18, 18 and 32. These numbers are also sometimes called magic numbers.

(1) The smallest ion among the following is..?

- (i) Na^+
- (ii) Al^{3+}
- (iii) Mg^{2+}
- (iv) Si^{4+}

(2) Considering the elements B, C, N, F and Si, the correct order of their non-metallic character is:

- (i) $F > N > C > B > Si$
- (ii) $Si > C > B > N > F$
- (iii) $B > C > Si > N > F$
- (iv) $F > N > C > Si > B$

OR

In a group of the periodic table the ionization enthalpies of the elements decreases from top to bottom because of?

- (i) increase in densities
- (ii) decrease in chemical reactivities
- (iii) increase in electronegativities
- (iv) decrease in atomic sizes

(3) The element with atomic number 26 will be found in group :

- (i) 2
- (ii) 8
- (iii) 6
- (iv) 10

(4) The elements with atomic numbers 9, 17, 35, 53, 85 are all....?

- (i) Alkaline earth metals
- (ii) Noble gases
- (iii) Halogens
- (iv) Transition metals

SECTION- E

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Q. No. 33 to 35 are Long Answer Type carrying 5 marks each.

33. (a) State Heisenberg's Uncertainty Principle and give its mathematical expression. Calculate the uncertainty in the momentum of an electron if it is confined to a linear region of length of 1×10^{-10} m.

(b) Derive de-Broglie's equation. [3+2]

OR

- (a) Write outer electronic configuration of Cr atom. Why half-filled orbitals more stable.
- (b) State the following with suitable examples- (i) Pauli's exclusion principle. (ii) Hund's rule.
- (iii) Aufbau rule [2+3]

34. (a) Define the term "hybridisation". Using the concept of hybridisation, explain the shapes of PCl_5 and BF_3 .

(b) Arrange sp , sp^2 and sp^3 hybridisations in increasing order of their electronegativities with appropriate reason of your answer. [3+2]

OR

- (a) Write two points of differences between sigma and pi bonds.
- (b) What is hydrogen bonding? What requirements should a molecule fulfil for the formation of H-bond?
- (c) Why boiling point of HCl is lower than the boiling point of HF as well as HBr? [2+2+1]

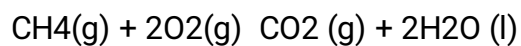
35. (a) Distinguish between state function and path function.

(b) Identify the state functions and path functions out of the following: enthalpy, entropy, heat, temperature.

(c) Change in internal energy is a state function while work is not, why? [2+2+1]

OR

(a) State Hess Law of constant heat summation. Calculate enthalpy change for the reaction:



The enthalpy of formation of $\text{CH}_4(\text{g})$, $\text{CO}_2(\text{g})$ and $\text{H}_2\text{O}(\text{l})$ are -74.8kJmol^{-1} , -393.5kJmol^{-1} and -285.8kJmol^{-1} respectively.

(b) What do you mean by thermochemical reactions? Give an example.

[3+2]



PM SHRI KENDRIYA VIDYALAYA BANSWARA
SESSION-2025-26 SUBJECT: CHEMISTRY

TIME: 3.00 HRS CLASS-XI SCIENCE HALF YEARLY EXAMINATION

MM.70

GENERAL INSTRUCTIONS:

Read the following instructions carefully.

1. There are 33 questions in this question paper with internal choice.
2. SECTION A consists of 16 multiple-choice questions carrying 1 mark each.
3. SECTION B consists of 5 short answer questions carrying 2 marks each.
4. SECTION C consists of 7 short answer questions carrying 3 marks each.
5. SECTION D consists of 2 case-based questions carrying 4 marks each.
6. SECTION E consists of 3 long answer questions carrying 5 marks each.
7. All questions are compulsory.
8. Use of log tables and calculators is not allowed.

QN	QUESTION	M
Section-A		
Question 1 to 16 are multiple choice questions. Only one of the choices is correct. Select and write the correct choice as well as the answer to these questions.		
1	22.4 L of a gas at NTP weighs 28 g. The gas is: (a) CO ₂ (b) C ₂ H ₄ (c) CH ₄ (d) C ₂ H ₂	1
2	If 4.4 g of CO ₂ contains 6.02×10^{22} molecules, the number of molecules in 11 g of CO ₂ will be: (N _A = 6.0×10^{23}) (a) 1.5×10^{23} (b) 3×10^{23} (c) 6×10^{23} (d) 4.5×10^{22}	1
3	The empirical formula of a compound is CH ₂ . Its molar mass is 84 g mol ⁻¹ . The molecular formula is: (a) C ₂ H ₄ (b) C ₄ H ₈ (c) C ₆ H ₁₂ (d) C ₇ H ₁₄	1
4	Which set of quantum numbers is not possible? (a) n = 3, l = 2, m = 0, s = +½ (b) n = 2, l = 2, m = -1, s = -½ (c) n = 4, l = 0, m = 0, s = +½ (d) n = 3, l = 1, m = -1, s = -½	1
5	The energy of an electron in the second Bohr orbit of hydrogen is: (a) -3.4 eV (b) -13.6 eV (c) -1.51 eV (d) -0.85 eV	1
6	Which electronic transition in the hydrogen atom emits radiation of the shortest wavelength? (a) n = 3 → n = 2 (b) n = 2 → n = 1 (c) n = 4 → n = 3 (d) n = 5 → n = 4	1

7	The uncertainty in the position of an electron is 5.3×10^{-11} m. The uncertainty in its momentum ($h = 6.6 \times 10^{-34}$ Js) is: (a) $\geq 6.25 \times 10^{-24}$ kg·m/s (b) $\geq 1.25 \times 10^{-24}$ kg·m/s (c) $\geq 3.5 \times 10^{-24}$ kg·m/s (d) $\geq 9.5 \times 10^{-24}$ kg·m/s	1
8	An element (X) is present in 18th group and 8th period of modern periodic table. Predict the atomic number of the X: (a) 115 (b) 82 (c) 118 (d) 95	1
9	The elements of group-16 are also called as chalcogens as they: (a) are highly reactive (b) they form salt present in oceans (c) they form most ores present in the earth's surface (d) they make suffocating gases	1
10	Which of the following pairs of compounds have same hybridization of central atom? (a) CH_4 / NH_3 (b) CO_2 / NO_2 (c) POCl_3 / SO_3 (d) both option (a) and (b)	1
11	Which of the following statement is not correct about PCl_5(gas)? (a) All P-Cl bonds are not equivalent (b) P- has sp^3d hybridization (c) Its shape is trigonal bipyramidal (d) It has two different types of bond angles	1
12	Which of the following statement(s) are correct in respect of C_2 diatomic species? (i) Its bond order is two (ii) It has one sigma and one pi bond (iii) It is paramagnetic in nature (iv) one of the BMO is vacant (a) (i) and (iv) (b) (i) and (iii) (c) (ii) and (iv) (d) All are correct	1
13	Assertion (A): H-N-H bond angle in NH_3 is smaller than that of H-N-H bond angle in NH_4^{+1} ion. Reason (R): The state of hybridization of N-atom in both is same Select the most appropriate answer from the options given below: A. Both A and R are true, and R is the correct explanation of A. B. Both A and R are true, and R is not the correct explanation of A. C. A is true but R is false. D. A is false but R is true	1
14	Assertion (A): 1M aq. solution of urea is more concentrated than 1 m aq solution of urea. Reason (R): Both solutions have same number of urea molecules when taken in same volume. Select the most appropriate answer from the options given below:	1

	A. Both A and R are true, and R is the correct explanation of A. B. Both A and R are true, and R is not the correct explanation of A. C. A is true but R is false. D. A is false but R is true	
15	Assertion (A): Bohr's model precisely locate an electron in a 2-D circular orbits of an atom Reason (R): Bohr's model of atom follows uncertainty principle of Heisenberg. Select the most appropriate answer from the options given below: A. Both A and R are true, and R is the correct explanation of A. B. Both A and R are true, and R is not the correct explanation of A. C. A is true but R is false. D. A is false but R is true	1
16	Assertion (A): CO_2 is linear but SO_2 is angular Reason (R): The dipole moment of both molecules is zero Select the most appropriate answer from the options given below: A. Both A and R are true, and R is the correct explanation of A. B. Both A and R are true, and R is not the correct explanation of A. C. A is true but R is false. D. A is false but R is true	1
Section-B Question No. 17 to 21 are very short answer questions carrying 2 marks each.		
17	Give reason for the following observations: (a) All C-O bonds in carbonate ion (CO_3^{2-}) are equivalent. (b) Ethyl alcohol is miscible with water in all proportions. OR Explain following observations: (i) NH_3 has higher dipole moment than that of NF_3 (ii) O- nitro phenol is steam volatile but not its m- and p- isomers.	2
18	How many total ions are present in 3.42 g of $\text{Al}_2(\text{SO}_4)_3$ [Al=27, S=32, O= 16]	2
19	(i) How many electrons can $5p_z$- orbital occupy? (ii) Write electronic configuration of Mn^{2+} ion. (Atomic number of Mn =25)	2
20	State following rule/principle: (a) Pauli's exclusion principle (b) Hund's rule of maximum multiplicity	2
21	Explain with diagram which bond will form when following orbitals overlap? (consider z- axis as the internuclear axis) (a) p_z and p_z- orbitals (b) p_x and p_x – orbitals	2

Section-C		
Question No. 22 to 28 are short answer questions, carrying 3 marks each.		
22	(a) How many nodes are present in the following molecular orbitals: (i) $\pi^*_{(2px)}$ (ii) $\pi^*_{(2pz)}$ (b) How will bond order change during following processes? (p) $B_2 \rightarrow B_2^{-1}$ (q) $O_2 \rightarrow O_2^{+1}$ (iii) Write Lewis structure of nitrate ion	3
23	Explain using MOT (molecular orbital theory): (a) Why is O_2 paramagnetic in nature (b) O_2^{+2} has smaller bond length than O_2^{-2} (c) Ne_2 does not exist	3
24	Give reason for the following observations: (i) The electron gain enthalpy of Chlorine (Cl) is more negative than that of Fluorine (F) although F is more electronegative than Cl (ii) The compounds of Cl and O are called oxides but that of F and O are called fluorides (iii) Na_2O in water make alkaline solution but Cl_2O make acidic solution	3
25	Find the velocity (m/s) of ejected electron from a metal (A) whose work function is 2.2 eV, when a photon of wave length equal to $4000 \text{ \AA}$ hits the metal surface.	3
26	A sample of $CaCO_3$ weighing x gram when added to 200mL of 0.25M aqueous HCl solution produced 448 mL of CO_2 gas at NTP. Find value of x	3
27	Attempt any three questions: (a) LiBr is appreciably soluble in organic solvents but not NaF although both are halide of alkali metals. Why? (b) $MgO(2852^\circ C)$ has much higher melting point than NaF ($993^\circ C$) despite both are ionic compounds. Explain (c) σ - bonds are stronger than π - bonds. Explain (d) Though NH_3 and PH_3 both are hydrides of same group -15 of periodic table, NH_3 gas dissolves fairly in water but PH_3 bubbles out. Why? (e) Draw resonating structures of O_3 (ozone molecule)	3
28	10 L of H_2 gas and 5L of N_2 gas under similar conditions are treated to form NH_3 gas according to following equation: $N_2 + 3H_2 \rightarrow 2NH_3$ (i) Which of the reagents will act as limiting reagent? (ii) What volume of NH_3 gas under similar conditions will form at the end of reaction?	3
Section D		
Question No. 29 & 30 are case-based/data -based questions carrying 4 marks each.		
29	Two students Adveta and Pratyancha of class XI science were asked to prepare 500 mL of 1 molar aqueous solution of urea ($NH_2-CO-NH_2$). Adveta weighed 30 g of urea and added it to 500 mL of distilled water and stirred the solution to get a clear solution. Pratyancha on the other hand weighed	

	30 g of urea and dissolved it to 300 mL of distilled water and later made up the solution to 500 mL by adding further distilled water. (a) Which of Adveta and Pratyancha is quantitatively correct? Why? (b) Whose solution out of Adveta and Pratyancha can be considered as 1 molal solution? Why? (c) What will be concentration of Pratyancha's solution, if it is diluted to 1000 mL by adding distilled water again? (d) How many molecules of urea will be present in 1 mL solution made by Pratyancha ?	1 1 1 1															
30	In 1913, Henry Moseley performed a series of experiments on X-ray spectra of elements. He bombarded target metals with high-energy electrons in an X-ray tube and recorded the frequencies of the emitted characteristic X-rays. He found a precise mathematical relation between the frequency (ν) of emitted X-rays and the atomic number (Z) of the element: $\sqrt{\nu} = a(z - b)$ Where a and b are constants for a given spectral series and ν is the frequency of the X- rays emitted. This discovery corrected Mendeleev's periodic table anomalies and firmly established that atomic number (Z) — not atomic mass — determines the identity and position of an element. The data below show experimental X-ray frequencies for four consecutive elements: <table> <tr> <th>Element</th><th>Atomic Number (Z)</th><th>Observed Frequency ($\times 10^{15}$ Hz)</th></tr> <tr> <td>Fe</td><td>26</td><td>3.30</td></tr> <tr> <td>Co</td><td>27</td><td>3.54</td></tr> <tr> <td>Ni</td><td>28</td><td>3.79</td></tr> <tr> <td>Cu</td><td>29</td><td>4.04</td></tr> </table>	Element	Atomic Number (Z)	Observed Frequency ($\times 10^{15}$ Hz)	Fe	26	3.30	Co	27	3.54	Ni	28	3.79	Cu	29	4.04	
Element	Atomic Number (Z)	Observed Frequency ($\times 10^{15}$ Hz)															
Fe	26	3.30															
Co	27	3.54															
Ni	28	3.79															
Cu	29	4.04															
	(a) How do you think the Moseley's experiment could solve the anomaly of Ni and Co in the Mendeleev's periodic table? (b) Plots the graph between square root of frequency and atomic number(Z) (c) State modern periodic law. (d) What is the unit of constant "a" in the Moseley's equation?	1 1 1 1															
Section-E Question No. 31 to 33 are long answer type questions carrying 5 marks each.																	
31	(a) What do you understand by dipole moment? Write its SI unit. (b) Which of NaCl and NaBr has greater covalent characters? Why? (c) Predict the shape of ClF_3 molecule using VSEPR theory. OR	2 2 1															

	(i) Explain hybridization using ethene(C ₂ H ₄) molecule. Draw orbital diagram of it.	2
	(ii) Predict shape of following molecules/ions with the help of VSEPR theory: XeOF ₄ and ClF ₄ ⁺¹	2
	(iii) Which type of bonds are present in NH₄Cl	1
32	(a) Derive Bohr's postulate of quantization of angular momentum with the help of de- Broglie's equation. (b) A proton of 1.67×10^{-27} kg is moving with a velocity of 2×10^4 m/s. Find de-Broglie's wavelength associated with it. (c) can an orbital have following set of quantum numbers? Why? $n = 3$, $l = 3$ and $m = -2$ OR (i) What do you understand by Zeeman effect and Starck effect? (ii) Write values of all four set of quantum numbers for last electron of K (potassium) (iii) Name the quantum number that predict: (a) shape of orbital (b) orientation of orbital	2 2 1 2 1 2
33	(A) Give reason for the following observations: (i) Cation is always smaller than its parent atom. (ii) Be shows resemblance in properties with Al and not with Mg of its own group. (iii) Halogens in their respective periods have most negative value of electron gain enthalpy. (B) Write two drawbacks of Mendeleev's periodic table OR (1) Explain following: (a) First ionization enthalpy of N is higher than that of O despite O has smaller atomic size. (b) Noble gases in their respective periods have largest atomic volume. (2) Define electron gain enthalpy. Write its unit. (3) How is electronegativity different than that of electron gain enthalpy?	3 2 2 1 2